Heart Rate during Group Flooding Therapy for PTSD

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Abstract—The objective of this study was to assess, via heart rate, the arousal levels of participants in group trauma reexposure therapy for posttraumatic stress disorder, and so to better understand this common mode of treatment, particularly in regards to its presumed curative factor, extinction. Six Vietnam combat-related PTSD inpatients participated twice weekly in group trauma reexposure therapy during which their electrocardiograms were recorded. Heart rate was quantified continuously off-line. Heart rates of participants *not* directly engaged in imaginal reexposure to their personal combat traumas consistently exhibited mild linear declines from the beginnings to the ends of the approximately 2.5 hour sessions. Participants actively engaged in personal combat trauma reexposure exhibited higher whole-session heart rates. Most also exhibited more specific elevation extending over the later portions of therapy sessions during which intensive reexposure usually occurred. Surprisingly, no patients exhibited *focal* increases in heart rate concurrent with periods of most intensive traumatic incident review as judged from videotape. Administering imaginal reexposure in a group context does not preclude substantial physiological (sympathetic) arousal, as is preconditional for extinction. Under conditions in which the actively engaged reexposure patient is reliably identified, group trauma reexposure therapy may not provide an opportunity for "vicarious" flooding in nonengaged participants.
Key words—stress, traumatic, heart rate, group therapy

Introduction

Among the treatment approaches to posttraumatic stress disorder (PTSD), controlled imaginal reexposure to the traumatic experience has arguably produced the most consistent benefits to patients (Blake et al., 1994; Solomon et al., 1992; Friedman and Southwick, 1995). Support for this approach has derived principally from clinical trials in which the treatment was delivered to individuals. Interest in the delivery of reexposure treatment to groups of traumatized patients has stemmed both from considerations of cost and availability, and from concern with patient retention and safety. Group treatment constitutes the primary modality by which trauma reexposure therapy is today administered by the largest provider of such services, the U.S. Department of Veterans Affairs. High drop-out rates have been observed from individual forms of trauma reexposure therapy (Foy et al., 1993), and serious complications have developed in some patients (Pitman et al., 1991). It has been proposed that group trauma reexposure therapy be explicitly constructed to incorporate the social support common to group treatment (Yalom, 1985) and a psychoeducational

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component aimed at symptom management and relapse prevention. A large-scale clinical trial of group treatment for PTSD following these guidelines is now underway within the U.S. Department of Veterans Affairs (Cooperative Study #420).

An underlying assumption of reexposure therapies such as implosion and flooding is that reactivation of the trauma-related fear/anxiety state, with concomitant physiological (sympathetic) arousal, is a precondition for extinction to occur (Boudewyns and Shipley, 1983). We are aware of only one published study that actually recorded indices of sympathetic arousal *during* reexposure therapy with individual PTSD patients.[1] Meuser et al. (1991) reported on four cases of Vietnam combat-related PTSD whose heart rates were recorded during imaginal trauma reexposure. Their observations suggested that clear habituation of heart rate reactivity to imaginal stressors over sessions of reexposure treatment predicted therapeutic gain. Of particular interest here is whether the camaraderie and social support cultivated in group treatment could actually militate *against* the development of fear and anxiety states necessary for desensitization/extinction to occur. We tested this hypothesis by measuring heart rate (HR) during the course of manualized group trauma reexposure treatment delivered to Vietnam combat-related PTSD inpatients at the National Center for PTSD, Clinical Laboratory and Education Division.

Methods

Subjects

Eight consecutively-admitted male Vietnam combat-related PTSD inpatients were assigned to the treatment group via routine clinical decision-making. That is, all were expected to tolerate and derive benefit from trauma reexposure therapy. The assignment decisions were not based upon reactivity to trauma-related imagery either as measured or estimated from self-reports. The data reported here come from eleven of twenty-eight group treatment sessions and from six of the eight originally assigned patients. This sample of patients and sessions met the following criteria. Each patient participated in at least six group treatment sessions for which adequate ECG and video recordings were available and in which there could be identified a period of markedly intensive imaginal trauma reexposure as judged from videotape. Second, each patient, himself, underwent at least one episode of intensive imaginal trauma reexposure that was adequately recorded (in five of six cases, there were two such sessions). Of the original eight patients, one was eliminated because he had attended only four treatment sessions, and the other because his trauma review sessions were not videotaped. Of the remaining nineteen sessions, most did not include traumatic incident review as per the manualized treatment program. In sum, we present here data from eleven of sixteen (69 percent) programmed imaginal trauma reexposure episodes from this course of group trauma reexposure treatment. Thus, the data presented are likely to be representative of the sessions not recorded.

Of the six patients we report upon below, all met DSM-III-R criteria for PTSD assessed via the Clinician-Administered PTSD Scale (CAPS, Blake et al., 1991). As assessed via the Structured Clinical Interview for the DSM-III-R (SCID; Spitzer et al., 1990), all six also met criteria for recurrent major depressive disorder, only one being in remission at the time of his participation in this study. One patient met criteria for panic disorder with agoraphobia. He and one other patient met criteria for social phobia. Five of six patients exhibited a history of alcohol dependence, and four of six, of a non-alcohol substance dependence. These rates of comorbidity, though high, are fairly typical of chronic severe

PTSD patients (Kulka et al., 1988; McFarlane & Papay, 1992; Green et al., 1992; Engdahl et al., 1991). All six patients were taking psychotropic medications during the course of their participation in group trauma reexposure treatment. Four were medicated on trazodone, three on fluoxetine, two on buspirone, one on divalproex sodium, one on carbamazepine, and one on amitriptyline. One patient was taking two medications recognized to suppress heart rate reactivity (lisinopril 40 mg/day, nifedipine 60 mg/day).

Procedures

Subjects arrived at the treatment room five minutes prior to the scheduled start of the group. Subjects self-applied disposable silver/silver-chloride electrodes to the medial surfaces of each wrist, chose a seat in the room, and connected their electrodes to leads hanging behind each chair. Though wrist derivations were not optimal from the standpoint of artifact, we assigned a high priority to minimizing the intrusiveness of our recording methods. The electrode leads were routed around the outside of the room to an electrode junction box mounted on the wall. A heavily shielded cable then conducted the ECG signals to a Grass Model 78 polygraph in the next room. ECG was filtered to a 10–30 Hz bandwidth prior to digitization. Again, though not ideal, these filtering parameters allowed optimal resolution of R-waves under the difficult recording conditions involved. The ECG signals were digitized at 125 Hz and streamed to disk using a data-acquisition interface to a laboratory computer (DATAQ Instruments, Akron, OH). A computer-based algorithm calculated R-R intervals and HRs on a four-second time-base. The use of a short time-base allowed us to more easily exclude artifactual epochs. This was accomplished by first requiring that the standard deviation of the interbeat interval be less than 10 msec. As both 60 Hz noise and high-frequency high-amplitude muscle artifact could produce signal epochs passing this criterion, a combination of range-checking and review of raw data was applied to the remaining epochs. Linear interpolation between nonartifactual epochs followed by a 15–point "boxcar" moving average filter yielded the final HR time-series. Both digital ECG records and videotape were time-stamped, and their registration was maintained within one second.

Group Trauma Reexposure Therapy Protocol

Patients at the National Center for PTSD, Clinical Laboratory and Education Division, are involved in an intensive inpatient program that emphasizes psychoeducational and process-oriented group psychotherapy aimed at reducing PTSD symptoms and treating comorbid disorders such as depression and substance abuse. At the time of this study, patients typically resided in the program for six months. After two to three months, patients were assigned to a "Trauma Focus" group. According to the manualized protocol administered to the patients in the current study, the initial set of group sessions were psychoeducational in format, intended to provide a cognitive structure incorporating PTSD, combat trauma, and coping, that supported the coming reexposure phase. The reexposure phase of treatment was then accomplished one patient at a time. Therapists guided each individual through an imaginal reexperience of his most severe combat traumas in such a way as to elicit and maintain the expression of distressing affects associated with those events. Two sessions were devoted to each individual's combat traumas. At the end of each reexposure session, the nonengaged participants were debriefed regarding the thoughts and emotions stimulated by the activity. The reexposure phase of treatment was followed by an integrative phase focusing upon relapse prevention and the maintenance of therapeutic gains.

Results

Mean Combat Exposure Score (CES; Keane et al., 1989) for the sample was 24.8 (s.d. 8). Mean score on the Mississippi Scale for Combat-Related PTSD (MISS) was 133.8 (s.d. 15.4). Beck Depression Inventory (BDI, Beck et al., 1961) scores were, on average, 29.8 (s.d. 9.3). These indices and the levels of comorbidity discussed above confirm that the participants in this study were highly symptomatic.

Figure 1 presents HR profiles for each of the eleven sessions analyzed. For each session, the HR of the individual undergoing trauma reexposure is plotted (in black) separately from the mean of the other participants (in grey). Also indicated via (grey) vertical lines are the break periods which typically occurred approximately one third of the way through the sessions, and (in black) the episodes of intensive imaginal re-exposure as judged from videotape. In nine of the eleven sessions reported upon here, these episodes occurred during the second two-thirds of the session. Clock time is represented along the x-axis. It can be seen that most sessions lasted approximately 2.5 hours.

The mean HR profiles of the participants not undergoing imaginal trauma reexposure were markedly consistent in exhibiting mild near-linear declines from the beginning to the ends of sessions. These declines typically amounted to approximately 5 beats per minute (BPM). (Variation in the mean levels of profiles in Figure 1 derives from the fact that different subgroups of patients contributed from session to session.) The continuity of these declines across break periods was notable in light of the frequency with which participants smoked cigarettes during breaks. The HR profiles of individuals undergoing imaginal reexposure were highly variable: some exhibited large increases in the later portions of treatment sessions during which most intense imaginal reexposure occurred; others exhibited relatively flat profiles. Consistent across these profiles, however, was the absence of any focused excursion in HR coincident with the period of most intense imaginal reexposure. Figure 2 portrays this point more strongly by plotting the mean of all eleven HR profiles recorded from participants undergoing imaginal reexposure *centered* on the midpoints of those periods judged most intense from videotape. As the most intense periods were typically only a few minutes long, the 26–minute epoch plotted in Figure 2 would seem to provide ample time to visualize any phasic evolution and resolution of arousal coincident with most intensive reexposure. No such morphology was in evidence. Figure 2 also reinforces a second feature of the individual plots in Figure 1, that the HR time series of group members not on the "hot seat" exhibited no reexposure-related morphology whatsoever.

Figure 3 presents the same HR data in another way, contrasting each individual's mean HR profile from sessions in which he was the actively engaged reexposure patient with his mean profile from sessions in which he was not. (As session lengths differed somewhat, these plots are truncated to the length of the shorter of the two therapy sessions in which the patient was the actively engaged patient, that is, for the five of six patients who provided two such sessions. As well, the terminal sections of nonreexposure session mean profiles necessarily represent averages taken over variable numbers of sessions.) Appreciable in Figure 3 is the overall consistency with which group participants' HRs were elevated when they were identified as the patient engaged in imaginal reexposure as compared to when they were not so identified. In four of six patients, this elevation

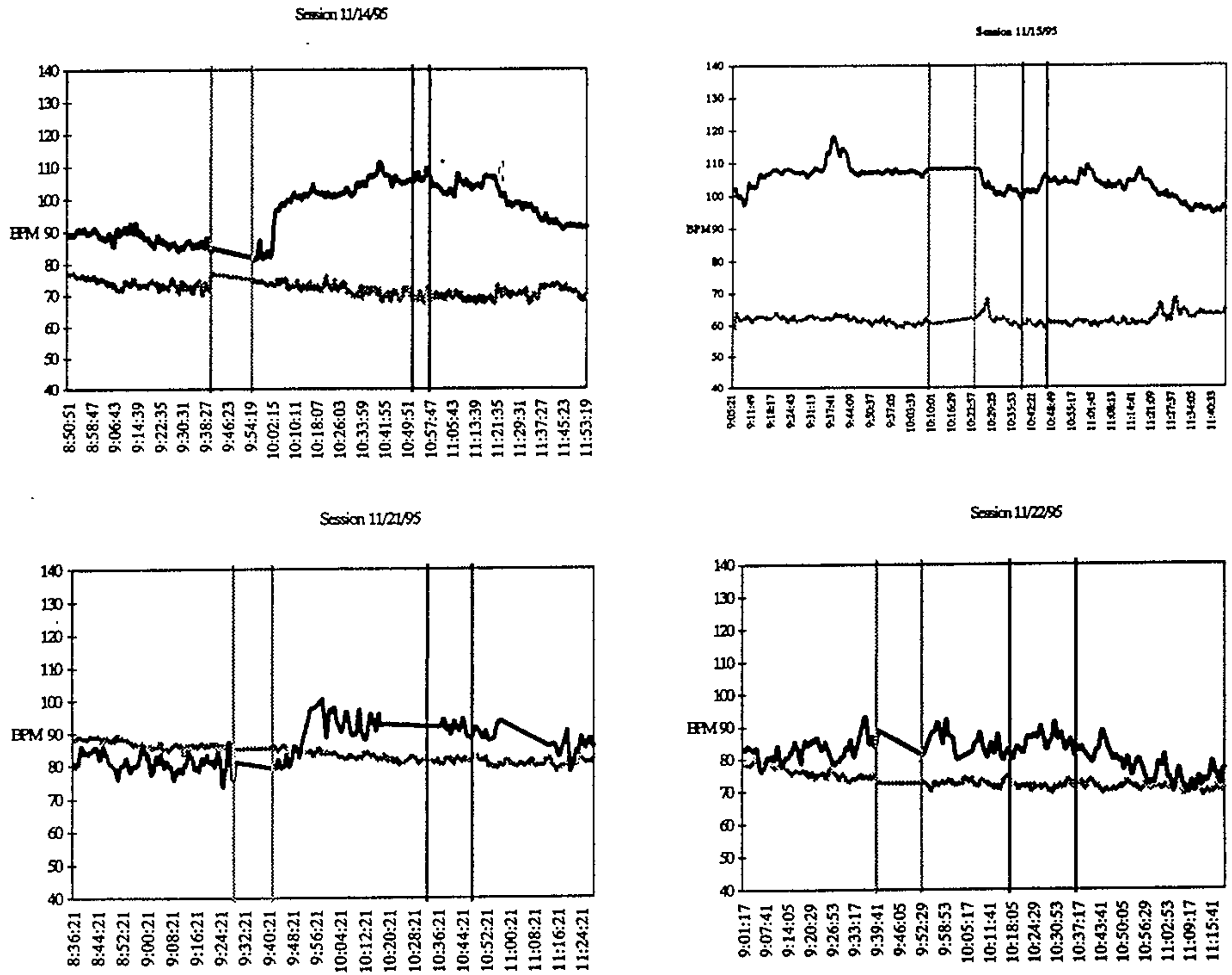

FIG. 1. All eleven group trauma reexposure sessions are represented in this figure. Each subplot contains two HR time series. The grey time series is the average computed over all patients not actively engaged in trauma reexposure during that session. The black time series plots the HR of the single patient who was so engaged. The black vertical lines indicate the period of intense imaginal reexposure judged from videotape. The grey vertical lines indicate the break period. Clock time is noted below the x-axis. Here, as in all subsequent figures, the y-axis represents HR in BPM.

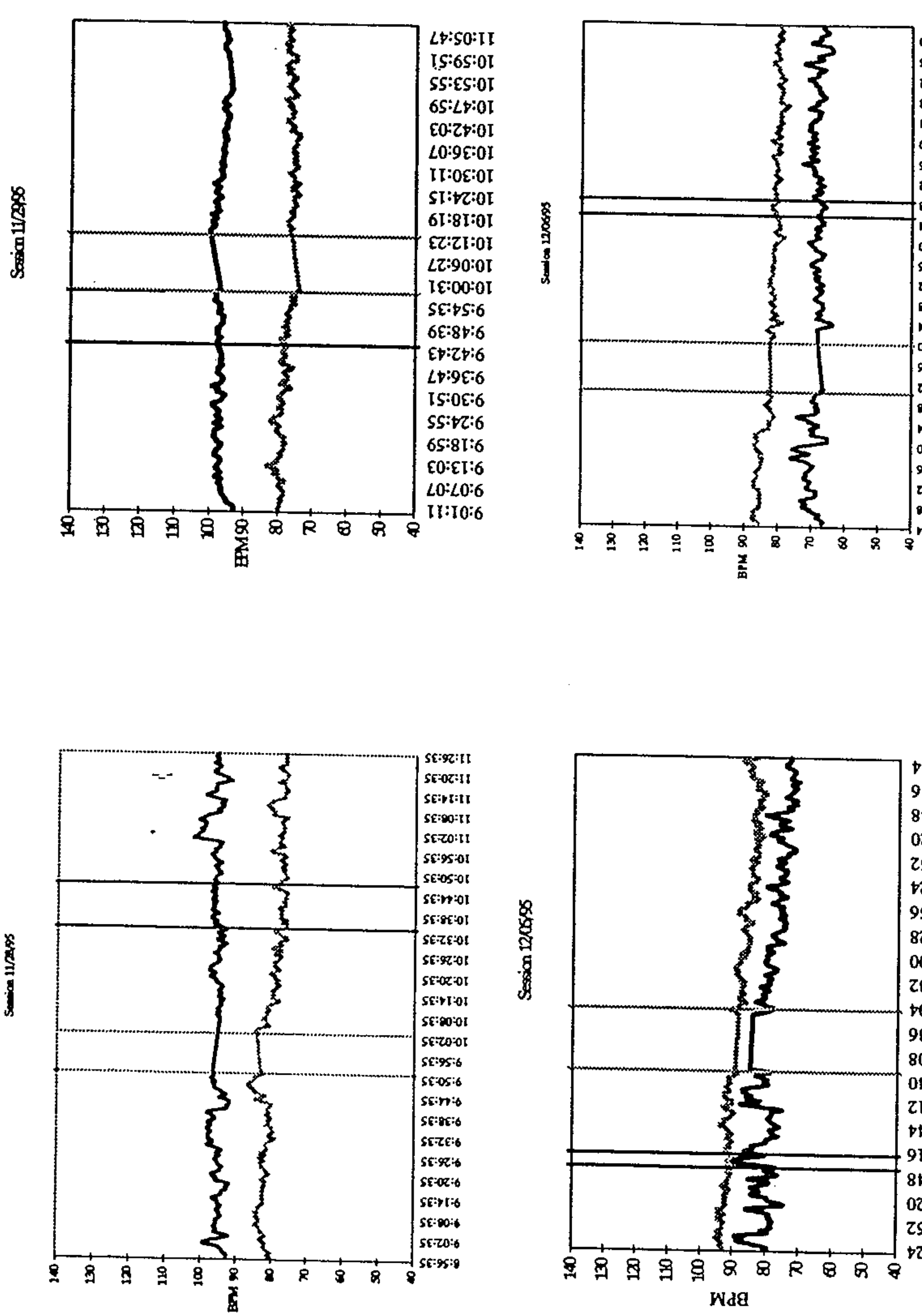

Fig. 1. *(Continued)*

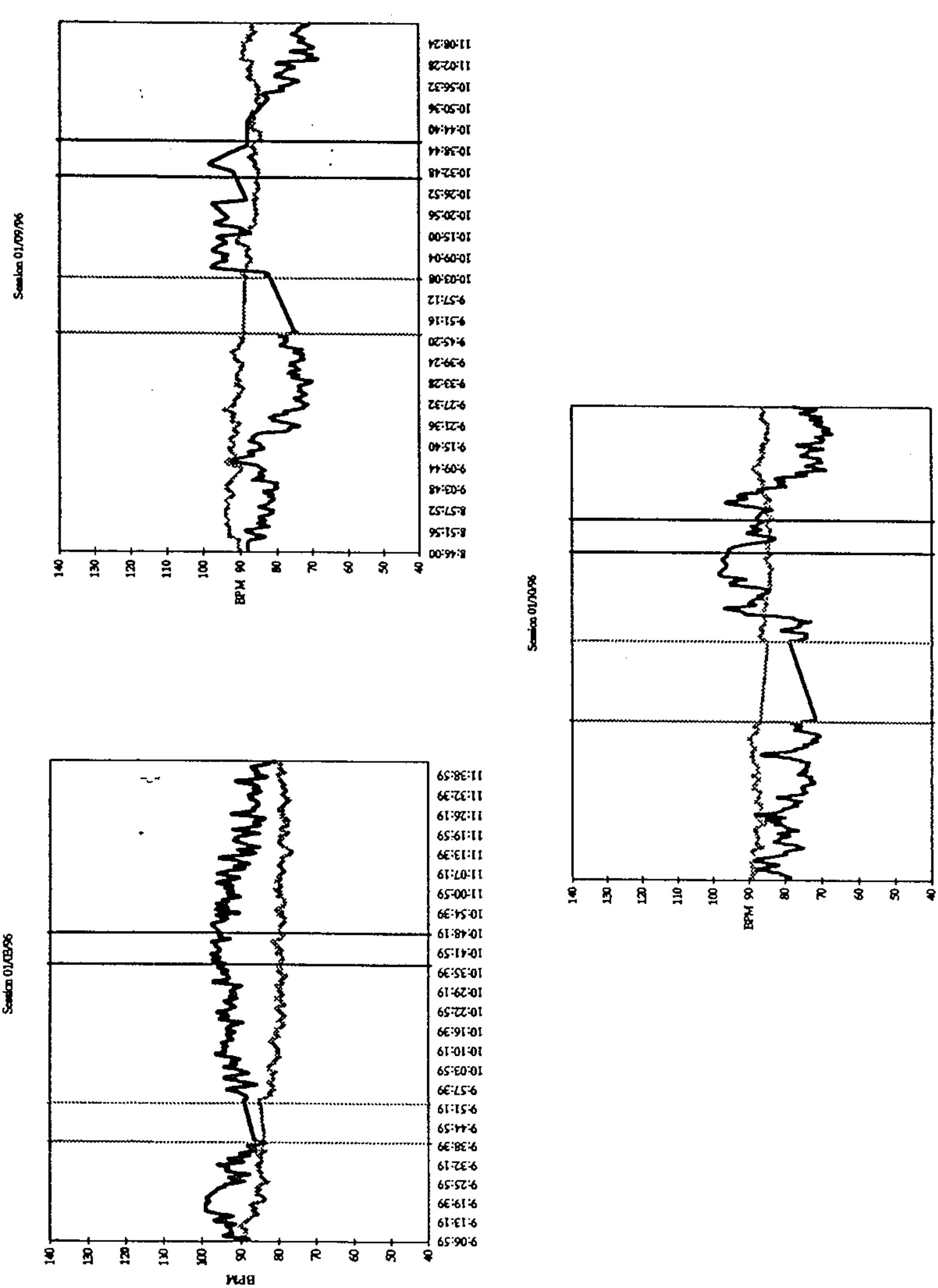

Fig. 1. *(Continued)*

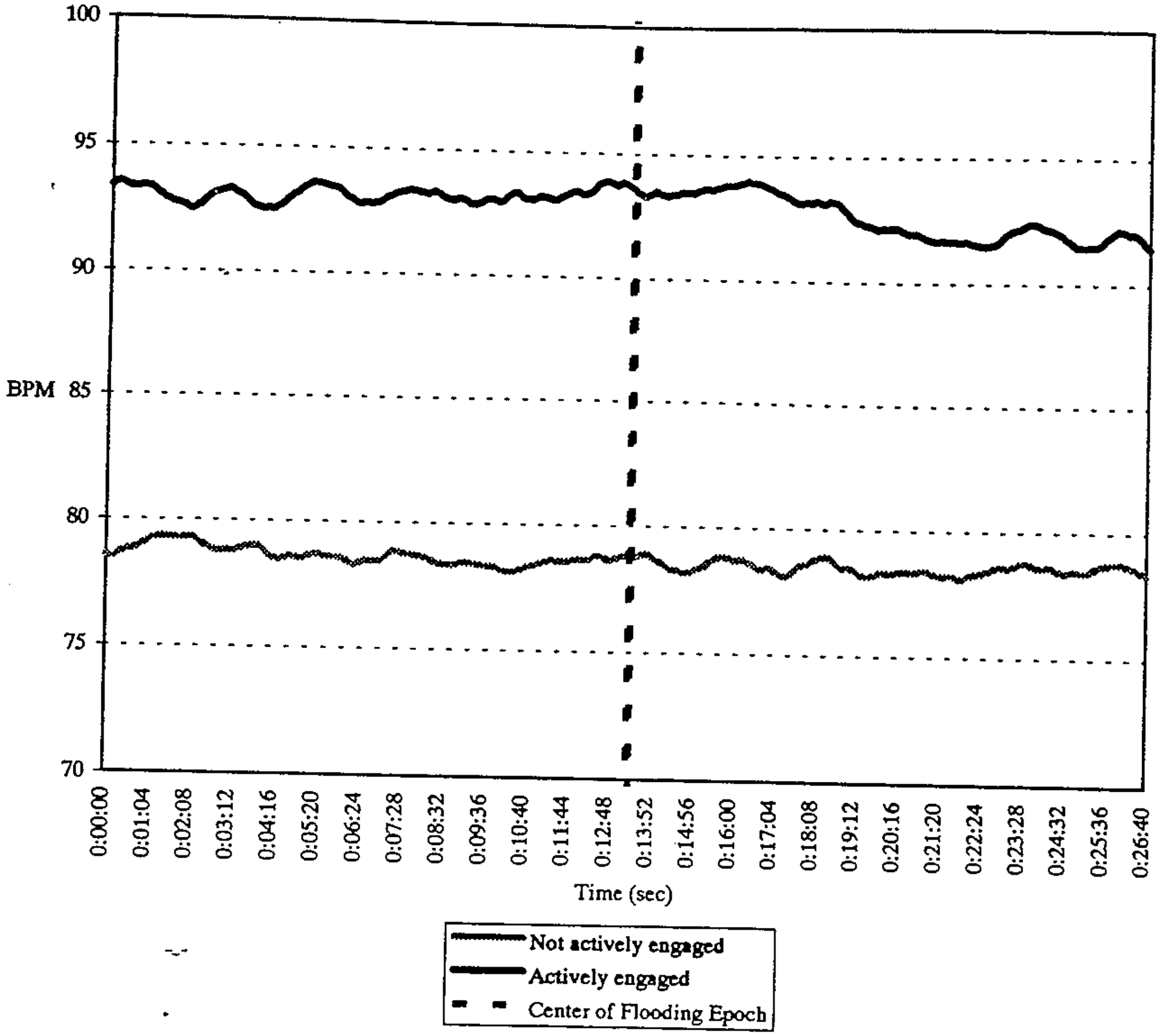

FIG. 2. Average of all HR profiles in Fig. 1 centered on periods of most intense imaginal reexposure as judged from videotape. The grey time series is the average over all sessions in which patients were not actively engaged in trauma reexposure. The black time series is the average over the session(s) in which the patients were so engaged. Total epoch duration is 26 minutes. Note the absence of any peaking in HR associated with periods of most intense imaginal reexposure.

favored the latter two-thirds of sessions during which most intense reexposure generally occurred. A fifth patient exhibited an elevation that was not specific to the latter two-thirds of sessions, while the sixth showed very little HR variation of any kind. It was later determined that this last patient was taking both an antihypertensive and an antianginal medication.

Figure 4 portrays the HR data averaged by the first, second, and third third of each session. A univariate repeated-measures ANOVA indicated that the interaction of session type (reexposure vs. nonreexposure) with time (first, second, third) was statistically significant ($F(2,10) = 23.99$, $p < 0.025$, $\varepsilon=0.7002$[2]). The main effects of time ($F(2,10) = 8.95$, $p < 0.029$) and session type ($F(1,5) = 6.39$, $p < 0.053$) were also statistically significant or nearly so despite the small sample size. Computing univariate contrasts, it was determined

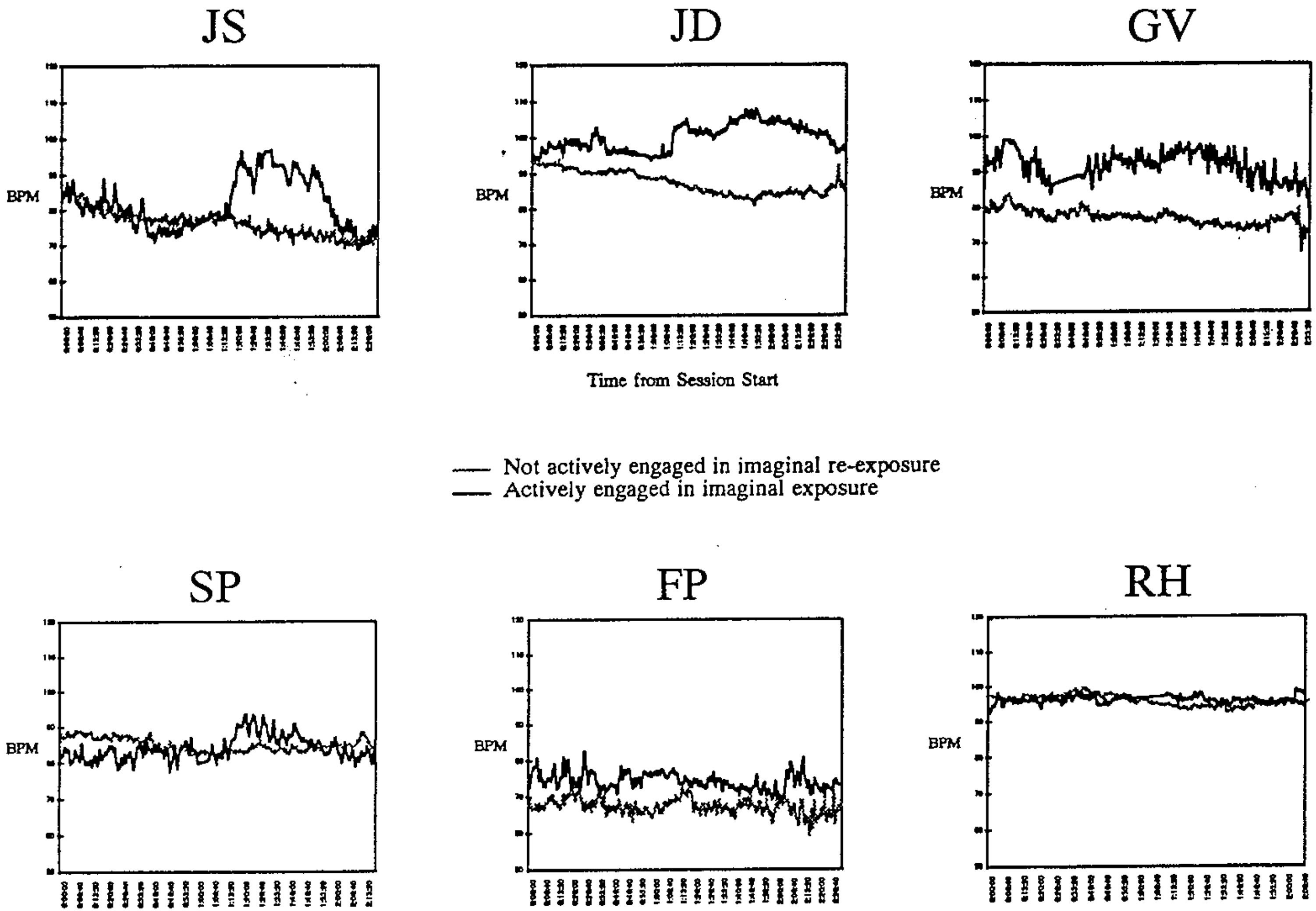

FIG. 3, Each of the above plots contains two averaged HR time series from a single patient. The grey time series is the average over all sessions in which the patient was not actively engaged in trauma reexposure. The black time series is the average over the session(s) in which the patient was so engaged. Note the tendency for HR to be elevated in the latter portions of sessions, during which most intensive imaginal reexposure occurred. Note also the variation across patients in exposure-driven HR, as contrasted with the consistent mild decline of HR during nonengaged sessions.

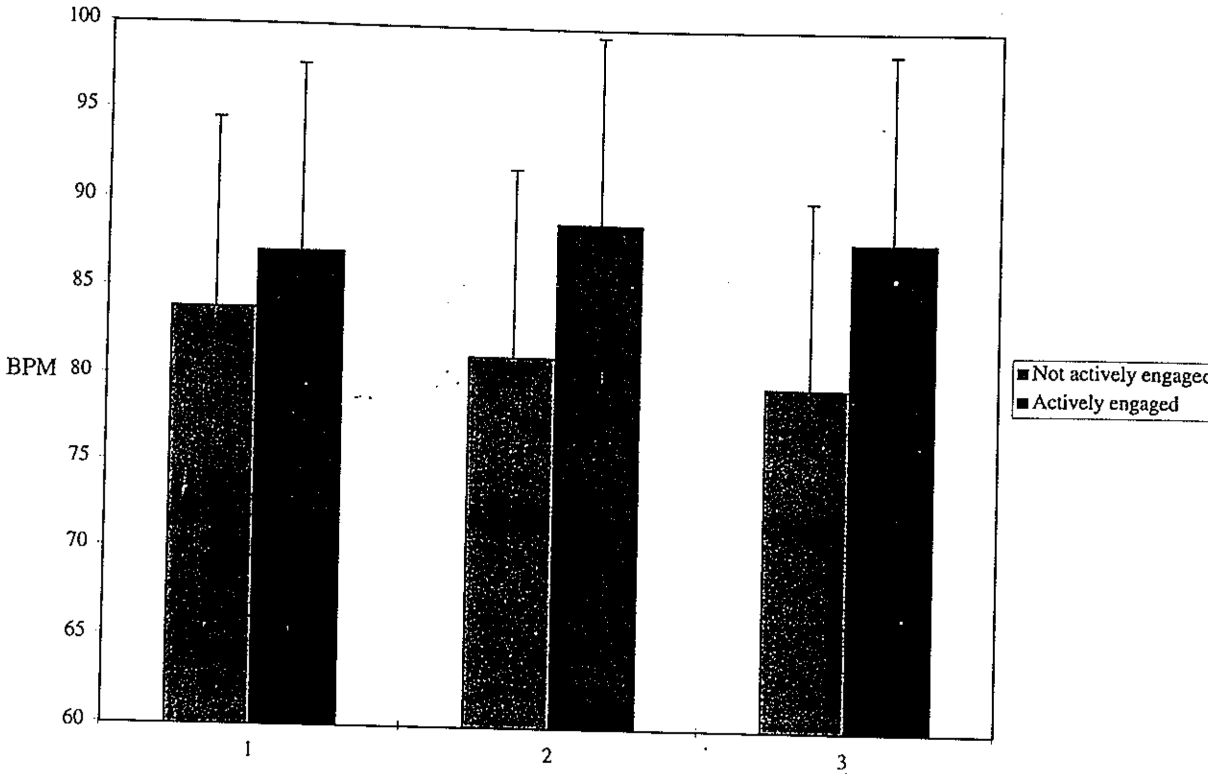

FIG. 4. Mean HR averaged over subjects and sessions, separated by session thirds. Grey bars represent the nonactively engaged condition, black bars, the actively engaged condition.

that the session type effect was significant at the second ($F(1,5) = 8.94$, $p < 0.03$) and third ($F(1,5) = 8.43$, $p < 0.034$) third of sessions, but not at the first ($F(1,5) = 1.54$, n.s.). Considering only nonreexposure HR, the reduction from the first third to the second was significant ($F(1,5) = 21.79$, $p < 0.005$) and the reduction from the second third to the third, nearly so ($F(1,5) = 5.10$, $p < 0.07$). Considering HR during reexposure sessions, the increase from the first third to the second was significant ($F(1,5) = 8.56$, $p < 0.033$), while the other contrasts were not (2 vs. 3: $F(1,5) = 0.603$, n.s.; 1 vs. 3: $F(1,5) = 0.601$, n.s.).

We also analyzed the HR data for their capacity to predict short-term benefit from group trauma reexposure therapy. Of particular interest to us was whether reactivity indicated by HR elevation during the latter portions of sessions was associated with benefit from reexposure treatment. Figure 3 is ordered according to the subjective salience of the HR reactivity following this pattern. While more objective and elaborate methods could have been used to quantify the magnitude of "slow" curvature in the HR time series, the small number of patients involved did not justify their application here. (Any such quantitative index would be retransformed to a simple ranking for subsequent analyses.) Two of us (RTM and JIR) who served as the group therapists in the study ranked the patients according to apparent global benefit from trauma reexposure. These rankings were performed independently and blind to the HR data. We also examined MISS scores acquired from patients before and after group treatment.

Remarkably close agreement was found between therapists' rankings of global benefit from trauma reexposure and independent rankings of apparent treatment-driven reactivity in individuals' HR profiles (Fig. 3; Spearman's rho = 0.943, $p < 0.01$). After debriefing the therapists (RTM and JIR), it became evident that a patient's display of overt congruent affect during imaginal trauma reexposure was the major factor underlying their rankings. Thus, perceived affectivity during reexposure corresponded to an index of HR reactivity. An examination of MISS scores pre- and post-group uncovered no direct correspondence between our ranking of HR reactivity and treatment benefit as indexed by self-reported PTSD symptomology. In fact, the relation between these rankings was negative (Spearman's rho = −0.70, n.s.). That is, the patient who had the most HR reactivity during imaginal reexposure (and the most overt congruent affectivity according to the group therapists) actually reported worsening in PTSD symptom severity on the MISS. Conversely, the patient with the least HR reactivity reported the most improvement in PTSD symptom severity.

Discussion

This study concerns the performance of only six patients engaged in group trauma reexposure therapy, so its conclusions must be regarded as provisional in that light. Acknowledging that caveat, important aspects of the data derived from this group appeared unambiguous. Substantial sympathetic arousal was observed in the group therapy context in those individuals actively engaged in trauma reexposure treatment. Participants' whole-session HRs were 3 BPM higher when they were the actively engaged reexposure patient than when they were not. The average differential rose to 8 BPM during the latter portions of sessions during which most intensive reexposure occurred. Not only were these differences during the latter portions of groups statistically significant, but they were larger than the HR increases typically observed in association with trauma cues in reactivity studies (Prins et al., 1995). In some cases, they were also sustained over substantial periods of time. By the same token, the differences in HR between engaged and nonengaged conditions was equally the result of the absence of HR elevation during the latter. Group members not actively engaged by the therapist in personal trauma reexposure demonstrated a gradual reduction in arousal as indexed by HR that extended throughout the sessions, including the brief episodes of most intense reexposure and traumatic incident review. Clearly, "vicarious flooding" was not evidenced by these six patients. In light of the fact that the nonengaged patients were in close proximity to and listening to a peer describing traumatic experiences similar to their own, the contrast between theirs' and the HR profiles of engaged patients is impressive. Assuming these six patients are not unique, a better understanding of the "mental set" underlying and sustaining *nonarousal* in some participants of trauma reexposure group therapy may be necessary to optimize this form of treatment.

A modest examination of relationships between HR reactivity during trauma reexposure and therapeutic gain produced a number of suggestive findings, which again must be considered in light of the small size of the study sample. When therapists were asked to estimate benefit from reexposure, their judgments corresponded remarkably to a ranking of "exposure-driven" HR reactivity derived from the HR time series (Fig. 3). On debriefing, it was determined that the therapists had spontaneously transformed "benefit from exposure" to "affectivity during exposure." In light of the broadly-held model of exposure therapy that regards physiologic (sympathetic) arousal as a precondition for extinction, the apparent accuracy with which two therapists could assess arousal via affectivity is heartening. Unfortunately, there were no such relationships observed between the rankings of arousal and affectivity and self-reported change in PTSD severity pre- and post-treatment. In fact, a trend toward the reverse relationship was observed. At least two possibilities should be considered in regards to this finding. It may be that those patients most "successfully" engaged in reexposure treatment will experience a temporary overwhelming of avoidant coping responses with temporary increases in PTSD symptom severities, but greater long-term therapeutic gain. This possibility deserves close scrutiny in future outcome research, particularly in light of the findings of Pitman et al. (1991), as it implies that the patients who "perform best" in reexposure treatment may be precisely those requiring the most intense post-exposure treatment follow-up. A second, more disturbing possibility is that, given the apparent absence of "vicarious flooding," the participants in this course of group therapy received insufficient numbers of reexposure episodes to promote extinction. Instead, individuals experienced sensitization in approximate proportion to the levels of physiologic reactivity and affectivity induced by reexposure. This possibility also deserves close scrutiny in future outcome research.

Finally, important improvements could be made with relative ease to the methodology we used in this study. First, this study relied almost exclusively on physiologic reactivity as a process measure, whereas both subjective distress and behavioral avoidance have been shown to be important parallel indices of reactivity during exposure therapy. Second, informal inquiries of patients made during the course of this study suggested that standard chest leads could have been used without undue intrusion upon the group process. In fact, the patients in this group interpreted the physiological recording not as intrusive but, rather, as indicative of the seriousness of the therapeutic enterprise in which they were engaged. Standard disposable ECG electrodes can be applied with little skin preparation and will produce stronger and less artifact-laden ECG signals than we obtained. Second, small sensitive lapel microphones could be placed so as to record breath sounds and speech. This signal could then be integrated and digitized at rates comparable to the EEG in order to provide both respiratory rate and speech rate information. While a high speech rate was noted in only one of the patients of this study (who did not stand as an extreme scorer either with regard to baseline HR or HR reactivity), the continuous indexing of speech rate as a contributor to cardiac rate elevation could be useful. The indexing of respiratory rate could provide important utility in that its combination with high-quality ECG signal would enable estimation of the respiratory sinus arrhythmia (Grossman et al., 1991), a continuous index of parasympathetic drive on the heart. By independently estimating parasympathetic drive, a richer picture of arousal status during trauma reexposure treatment could be derived from the ECG (Berntson et al., 1991, 1993; Porges, 1995).

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Notes

1. One such study is in progress (Resick, personal communication).
2. Huynh-Felt corrections for nonsphericity used.

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